

Guidelines for the Humane Killing of Animals for Disease Control Purposes

Article 1

General principles

This chapter is based on the premise that a decision to kill the animals has been made.

- All personnel involved in the humane killing of animals should have the relevant skills and competencies.
- As necessary, operational procedures should be adapted to the specific circumstances operating on the premises and should address, apart from animal welfare, operator safety, biosecurity and environmental aspects.
- Following the decision to kill the animals, killing should be carried out as quickly as possible and normal husbandry should be maintained until the animals are killed.
- The handling and movement of animals should be minimised and when done, it should be done in accordance with the guidelines described below.
- Animal restraint should be sufficient to facilitate effective killing, and in accordance with animal welfare and operator safety requirements; when restraint is required, killing should follow with minimal delay.
- When animals are killed for disease control purposes, methods used should result in immediate death or immediate loss of consciousness lasting until death; when loss of consciousness is not immediate, induction of unconsciousness should be non-aversive and should not cause anxiety, pain, distress or suffering in the animals.
- For animal welfare considerations, young animals should be killed before older animals; for biosecurity considerations, infected animals should be killed first, followed by in-contact animals, and then the remaining animals.
- There should be continuous monitoring of the procedures to ensure they are consistently effective with regard to animal welfare, operator safety and biosecurity.
- When the operational procedures are concluded, there should be a written report describing the practices adopted and their effect on animal welfare, operator safety and biosecurity.
- To the extent possible to minimise public distress, killing of animals and carcase disposal should be carried out away from public view.
- These general principles should also apply when animals need to be killed for other purposes such as after natural disasters.

Article 2

Organisational structure

Disease control contingency plans should be in place at a national level and should contain details of management structure, disease control strategies and operational procedures; animal welfare considerations should be addressed within these disease control contingency plans. The plans should also include a strategy to ensure that an adequate number of personnel trained in the humane killing of animals is available.

Disease control contingency plans should address the animal welfare issues that may result from animal movement controls.

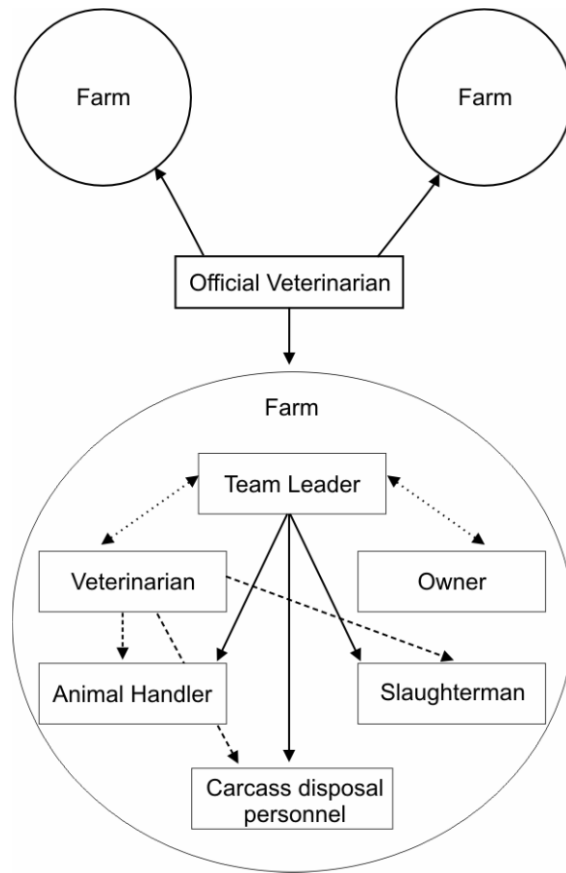
The operational activities should be led by an *official veterinarian* who has the authority to appoint the personnel in the specialist teams and ensure that they adhere to the required animal welfare and biosecurity standards. When appointing the personnel, he/she should ensure that the personnel involved has the required competencies.

The *official veterinarian* should be responsible for all activities across one or more affected premises and should be supported by coordinators for planning (including communications), operations and logistics to facilitate efficient operations.

The *official veterinarian* should provide overall guidance to personnel and logistic support for operations on all affected premises to ensure consistency in adherence to the OIE animal welfare and animal health guidelines.

A specialist team, led by a team leader answerable to the *official veterinarian*, should be deployed to work on each affected premises. The team should consist of personnel with the competencies to conduct all required operations; in some situations, personnel may be required to fulfil more than one function. Each team should contain a veterinarian.

In considering the animal welfare issues associated with killing animals, the key personnel, their responsibilities and competencies required are described in Article 3.



Article 3

Responsibilities and competencies of the specialist team

Team leader

- Responsibilities
 - plan overall operations on an affected premises
 - determine and address requirements for animal welfare, operator safety and biosecurity
 - organise, brief and manage team of people to facilitate humane killing of the relevant animals on the premises in accordance with national regulations and these guidelines
 - determine logistics required
 - monitor operations to ensure animal welfare, operator safety and biosecurity requirements are met
 - report upwards on progress and problems
 - provide a written report at the conclusion of the killing, describing the practices adopted and their effect on animal welfare
- Competencies
 - appreciation of animal welfare and the underpinning behavioural, anatomical and physiological processes involved in the killing process
 - skills to manage all activities on premises and deliver outcomes on time
 - awareness of psychological effects on farmer, team members and general public
 - effective communication skills

Veterinarian

- Responsibilities
 - determine and implement the most appropriate killing method to ensure that animals are killed without avoidable pain and distress
 - determine and implement the additional requirements for animal welfare, including the order of killing
 - minimise the risk of disease spread within and from the premises through the supervision of biosecurity procedures
 - continuously monitor animal welfare and biosecurity procedures
 - in cooperation with the leader, prepare a written report at the conclusion of the killing, describing the practices adopted and their effect on animal welfare

- Competencies
 - ability to assess animal welfare, especially the effectiveness of stunning and killing and to correct any deficiencies
 - ability to assess biosecurity risks

Animal handlers

- Responsibilities
 - review on-site facilities in terms of their appropriateness
 - design and construct temporary animal handling facilities, when required
 - move and restrain animals
- Competencies
 - experience of animal handling in emergency situations and in close confinement

Slaughterers

- Responsibilities
 - ensure humane killing of animals through effective stunning and killing
- Competencies
 - when required by regulations, licensed to use necessary equipment or licensed to be slaughterers
 - competent to use and maintain relevant equipment
 - competent to use techniques for the species involved
 - competent to assess effective stunning and killing

Carcase disposal personnel

- Responsibilities
 - ensure efficient carcase disposal (to ensure killing operations are not hindered)
- Competencies
 - competent to use and maintain available equipment and apply techniques for the species involved

Farmer / owner / manager

- Responsibilities
 - assist when requested
- Competencies
 - specific knowledge of his/her animals and their environment

Article 4

Operational guidelines

Planning the humane killing of animals

Many activities will need to be conducted on affected premises, including the humane killing of animals. The team leader should develop a plan for humanely killing animals on the premises which should include consideration of:

- Minimising handling and movement of animals
- Killing the animals on the affected premises; however, there may be circumstances where the animals may need to be moved to another location for killing; when the killing is conducted at an abattoir, the guidelines in the Chapter on slaughter of animal for human consumption should be followed.
- The species, number, age and size of animals to be killed, and the order of killing them
- Methods of killing the animals, and their cost
- Housing and location of the animals
- The availability and effectiveness of equipment needed for killing of the animals
- The facilities available on the premises that will assist with the killing
- Biosecurity and environmental issues
- The health and safety of personnel conducting the killing
- Any legal issues that may be involved, for example where restricted veterinary drugs or poisons may be used, or where the process may impact on the environment, and
- The presence of other nearby premises holding animals.

In designing a killing plan, it is essential that the method chosen be consistently reliable to ensure that all animals are humanely and quickly killed.

Article 5

Table summarising killing methods described in Articles 6-17*

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
Cattle	All	free bullet	no	non-lethal wounding	
	all except neonates	captive bolt - penetrating, followed by pithing or bleeding	yes	ineffective stunning	
	adults only	captive bolt - non-penetrating, followed by bleeding	yes	ineffective stunning, regaining of consciousness before killing	
	calves only	electrical, two stage application	yes	pain associated with cardiac arrest after ineffective stunning	
	calves only	electrical, single application (method 1)	yes	ineffective stunning	
	All	injection with barbiturates and others	yes	non-lethal dose, pain associated with injection site	

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
Sheep and goats	all	free bullet	no	non-lethal wounding	
	all except neonates	captive bolt - penetrating, followed by pithing or bleeding	yes	ineffective stunning, regaining of consciousness before killing	
	all except neonates	captive bolt - non-penetrating, followed by bleeding	yes	ineffective stunning, regaining of consciousness before killing	
	neonates	captive bolt - non-penetrating	yes	non-lethal wounding	
	all	electrical, two stage application	yes	pain associated with cardiac arrest after ineffective stunning	
	all	electrical, single application (Method 1)	yes	ineffective stunning	
	neonates only	CO ₂ air mixture	yes	slow induction of unconsciousness, aversiveness of induction	
	neonates only	nitrogen/inert gas mixed with CO ₂	yes	slow induction of unconsciousness, aversiveness of induction	
	neonates only	Nitrogen/inert gases	yes	slow induction of unconsciousness,	
	all	injection of barbiturates and others	yes	non-lethal dose, pain associated with injection site	
pigs	all	free bullet	no	non-lethal wounding	
	all except neonates	captive bolt - penetrating, followed by pithing or bleeding	yes	ineffective stunning,	

	neonates only	captive bolt - non-penetrating	yes	non-lethal wounding	
	All §	electrical, two stage application	yes	pain associated with cardiac arrest after ineffective stunning	

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
	All	electrical, single application (Method 1)	yes	ineffective stunning	
	neonates only	CO ₂ air mixture	yes	slow induction of unconsciousness, aversiveness of induction	
	neonates only	nitrogen/inert gas mixed with CO ₂	yes	slow induction of unconsciousness, aversiveness of induction	
	neonates only	Nitrogen/inert gases	yes	slow induction of unconsciousness,	
	All	injection with barbiturates and others	yes	non-lethal dose, pain associated with injection site	
poultry	adults only	captive bolt - non-penetrating	yes	ineffective stunning	
	day-olds and eggs only	maceration	no	non-lethal wounding, non- immediacy;	
	adults only	electrical single application (Method 2)	yes	ineffective stunning	
	adults only	electrical single application, followed by killing (Method 3)	yes	ineffective stunning; regaining of consciousness before killing	
	All	CO ₂ air mixture Method 1 Method 2	yes no	slow induction of unconsciousness, aversiveness of induction	
	All	nitrogen/inert gas mixed with CO ₂	yes	slow induction of unconsciousness, aversiveness of induction	
	All	Nitrogen/inert gases	yes	slow induction of unconsciousness	

	All	injection of barbiturates and others	yes	non-lethal dose, pain associated with injection site	
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Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
	adults only	addition of anaesthetics to feed or water, followed by an appropriate killing method	no	ineffective or slow induction of unconsciousness	

- * the methods are described in the order of mechanical, electrical and gaseous, not in an order of desirability from an animal welfare viewpoint
- § the only preclusion against the use of this method for neonates is the design of the stunning tongs that may not facilitate their application across such a small-sized head/body.

Article 6

Free bullet

Introduction

A free bullet is a projectile fired from a shotgun, rifle, handgun or purpose-made humane killer.

The most commonly used firearms for close range use are:

- humane killers (specially manufactured/adapted single-shot weapons)
- shotguns (12, 16, 20, 28 bore and .410)
- rifles (.22 rimfire)
- handguns (various calibres from .32 to .45)

The most commonly used firearms for long range use are:

- rifles (.22, .243, .270 and .308)

A free bullet used from long range should be aimed to penetrate the skull or soft tissue at the top of the neck of the animal, to cause irreversible concussion and death and should only be used by properly trained and competent marksmen.

Requirements for effective use

- The marksman should take account of human safety in the area in which he/she is operating
- The marksman should ensure that the animal is not moving and in the correct position to enable accurate targeting and the range should be as short as possible (5 –50 cm for a shotgun) but the barrel should not be in contact with the animal's head
- The correct cartridge, calibre and type of bullet for the different species age and size should be used. Ideally the ammunition should expand upon impact and dissipate its energy within the cranium

- Shot animals should be checked to ensure the absence of brain stem reflexes.

Figure 1. The optimum shooting position for cattle is at the intersection of two imaginary lines drawn from the rear of the eyes to the opposite horn buds.



Figure 2. The optimum shooting position for hornless sheep and goats is on the midline, just above the eyes and directing the shot down the line of the spinal chord.



Figure 3. The optimum shooting position for heavily horned sheep and horned goats is behind the poll.



Figure 4. The optimum shooting position for pigs is just above the eyes and directing the shot down the line of the spinal chord.



Advantages

- Used properly, it provides a quick and effective method for killing
- It requires minimal or no restraint and can be use to kill from a distance
- It is suitable for killing agitated animals in open spaces

Disadvantages

- Potentially dangerous to humans and other animals in the area
- Potential for non-lethal wounding
- Destruction of brain tissue may preclude diagnosis of some diseases
- Leakage of bodily fluids may present a biosecurity risk
- Legal requirements may preclude or restrict use
- Limited availability of competent personnel

Conclusions

- A suitable method for cattle, sheep, goats and pigs, including large animals in open spaces.

Article 7

Penetrating captive bolt

Introduction

A penetrating captive bolt is fired from a gun powered by either compressed air or a blank cartridge. There is no free projectile.

The captive bolt should be aimed on the skull in a position to penetrate the cortex and mid-brain of the animal. The impact of the bolt on the skull produces unconsciousness. Physical damage to the brain caused by penetration of the bolt may result in death, however pithing or bleeding should be performed as soon as possible after the shot to ensure the death of the animal.

Requirements for effective use

- For cartridge powered and compressed air guns, the bolt velocity and the length of the bolt should be appropriate to the species and type of animal, in accordance with the manufacturer's recommendations
- Captive bolt guns should be frequently cleaned and maintained in good working condition
- More than one gun may be necessary to avoid overheating and a back-up gun should be available in the event of an ineffective shot
- Animals should be restrained; at a minimum they should be penned for cartridge powered guns and in a race for compressed air guns
- The operator should ensure that the animal's head is accessible
- The operator should fire the captive bolt at right angles to the skull in the optimal position (see figures 1, 3 & 4. The optimum shooting position for hornless sheep is on the highest point of the head, on the midline and aim towards the angle of the jaw)
- To ensure the death of the animal, pithing or bleeding should be performed as soon as possible after stunning
- Animals should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes

Advantages

- Mobility of cartridge powered equipment reduces the need to move animals
- Immediate onset of a sustained period of unconsciousness

Disadvantages

- Poor gun maintenance and misfiring, and inaccurate gun positioning and orientation may result in poor animal welfare
- Post stun convulsions may make pithing difficult and hazardous
- Difficult to apply in agitated animals

- Repeated use of a cartridge powered gun may result in over-heating
- Leakage of bodily fluids may present a biosecurity risk
- Destruction of brain tissue may preclude diagnosis of some diseases

Conclusion

A suitable method for cattle, sheep, goats and pigs (except neonates), when followed by pithing.

Article 8

Captive bolt - non-penetrating

Introduction

A non-penetrating captive bolt is fired from a gun powered by either compressed air or a blank cartridge. There is no free projectile.

The gun should be placed on the front of the skull to deliver a percussive blow which produces unconsciousness in cattle (adults only), sheep, goats and pigs, and death in poultry and neonate sheep, goats and pigs. In mammals, bleeding should be performed as soon as possible after the blow to ensure the death of the animal.

Requirements for effective use

- For cartridge powered and compressed air guns, the bolt velocity should be appropriate to the species and type of animal, in accordance with the manufacturer's recommendations
- Captive bolt guns should be frequently cleaned and maintained in good working condition
- More than one gun may be necessary to avoid overheating and a back-up gun should be available in the event of an ineffective shot
- Animals should be restrained; at a minimum mammals should be penned for cartridge powered guns and in a race for compressed air guns; birds should be restrained in cones, shackles, crushes or by hand.
- The operator should ensure that the animal's head is accessible
- The operator should fire the captive bolt at right angles to the skull in the optimal position (figures 1-5)
- To ensure death in non-neonate mammals, bleeding should be performed as soon as possible after stunning
- Animals should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes

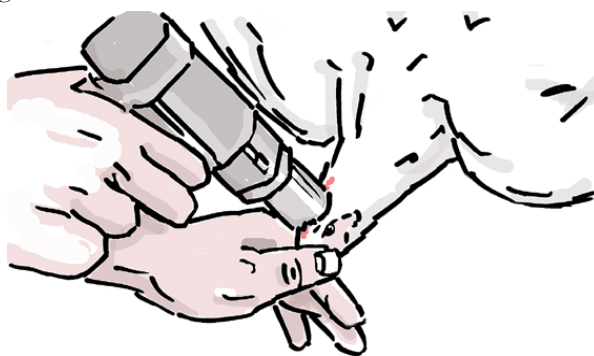


Figure 5. The optimum shooting position for

Advantages

- Immediate onset of unconsciousness, and death in birds and neonates
- Mobility of equipment reduces the need to move animals

Disadvantages

- As consciousness can be regained quickly in non-neonate mammals, they should be bled as soon as possible after stunning
- Laying hens in cages have to be removed from their cages and most birds have to be restrained
- Poor gun maintenance and misfiring, and inaccurate gun positioning and orientation may result in poor animal welfare
- Post stun convulsions may make bleeding difficult and hazardous
- Difficult to apply in agitated animals; such animals may be sedated in advance of the killing procedure
- Repeated use of a cartridge powered gun may result in over-heating
- Bleeding may present a biosecurity risk

Conclusions

- A suitable method for poultry, and neonate sheep, goats and pigs.
- If bleeding does not present a biosecurity issue, this is a suitable method for cattle (adults only), and non-neonate sheep, goats and pigs.

Article 9

Maceration

Introduction

Maceration, utilising a mechanical apparatus with rotating blades or projections, causes immediate fragmentation and death in day-old poultry and embryonated eggs

Requirements

- Maceration requires specialised equipment which should be kept in excellent working order
- The rate of introducing the birds should not allow the equipment to jam, birds to rebound from the blades or the birds to suffocate before they are macerated

Advantages

- Procedure results in immediate death
- Large numbers can be killed quickly

Disadvantages

- Specialised equipment is required
- Macerated tissues may present a biosecurity issue

Conclusion

A suitable method for killing day-old poultry and embryonated eggs.

Article 10

Electrical – two stage application

Introduction

A two stage application of electric current comprises firstly an application of current to the head by scissor-type tongs, immediately followed by an application of the tongs across the chest in a position that spans the heart.

The application of sufficient electric current to the head will induce ‘tonic/clonic’ epilepsy and unconsciousness. Once the animal is unconscious, the second stage will induce ventricular fibrillation (cardiac arrest) resulting in death. The second stage (the application of low frequency current across the chest) should only be applied to unconscious animals to prevent unacceptable levels of pain.



Figure 6. Scissor-type stunning tongs.

Requirements for effective use

- The stunner control device should generate a low frequency (30 – 60 Hz) current with a minimum voltage of 250 volts true RMS under load.
- Appropriate protective clothing (including rubber gloves and boots) should be worn.
- Animals should be restrained, at a minimum free-standing in a pen, close to an electrical supply.
- Two team members are required, the first to apply the electrodes and the second to manipulate the position of the animal to allow the second application to be made.
- A stunning current should be applied via scissor-type stunning tongs in a position that spans the brain for a minimum of 3 seconds; immediately following the application to the head, the electrodes should be transferred to a position that spans the heart and the electrodes applied for a minimum of 3 seconds.
- Electrodes should be cleaned regularly and after use, to enable optimum electrical contact to be maintained.
- Animals should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes.

Advantages

- The application of the second stage minimises post-stun convulsions and therefore the method is particularly effective with pigs.
- Non-invasive technique minimises biosecurity risk.

Disadvantages

- Requires a reliable supply of electricity.
- The electrodes must be applied and maintained in the correct positions to produce an effective stun and kill.

- Most stunner control devices utilise low voltage impedance sensing as an electronic switch prior to the application of high voltages; in unshorn sheep, contact impedance may be too high to switch on the required high voltage (especially during stage two).
- The procedure may be physically demanding, leading to operator fatigue and poor electrode placement.

Conclusion

- A suitable method for calves, sheep and goats, and especially for pigs (over one week of age).

Article 11

Electrical – single application

Introduction

Method 1 comprises the single application of sufficient electrical current to the head and back, to simultaneously stun the animal and fibrillate the heart. Provided sufficient current is applied in a position that spans both the brain and heart, the animal will not recover consciousness.

Method 2 stuns and kills by drawing inverted and shackled poultry through an electrified waterbath stunner. Electrical contact is made between the ‘live’ water and earthed shackle and, when sufficient current is applied, poultry will be simultaneously stunned and killed.

Method 3 comprises the single application of sufficient electrical current to the head of poultry in a position that spans the brain, causing unconsciousness; this is followed by a killing method (Article 17).

Method 1

Requirements for effective use

- The stunner control device should generate a low frequency (30 – 60 Hz) current with a minimum voltage of 250 volts true RMS under load.
- Appropriate protective clothing (including rubber gloves and boots) should be worn.
- Animals should be individually and mechanically restrained close to an electrical supply as the maintenance of physical contact between the stunning electrodes and the animal is necessary for effective use.
- The rear electrode should be applied to the back, above or behind the heart, and then the front electrode in a position that is forward of the eyes, with current applied for a minimum of 3 seconds.
- Electrodes should be cleaned regularly between animals and after use, to enable optimum electrical contact to be maintained.
- Water or saline may be necessary to improve electrical contact with sheep.
- An effective stun and kill should be verified by the absence of brain stem reflexes.

Advantages

- Stuns and kills simultaneously.
- Minimises post-stun convulsions and therefore is particularly effective with pigs.
- A single team member only is required for the application.
- Non-invasive technique minimises biosecurity risk.

Disadvantages

- Requires individual mechanical animal restraint.
- The electrodes must be applied and maintained in the correct positions to produce an effective stun and kill.
- Requires a reliable supply of electricity.

Conclusions

- A suitable method for calves, sheep, goats, and pigs (over 1 week of age).

Method 2

Requirements for effective use

- A mobile waterbath stunner and a short loop of processing line are required.
- A low frequency (30-60 Hz) current applied for a minimum of 3 seconds is necessary to stun and kill the birds.
- Poultry need to be manually removed from their cage, house or yard, inverted and shackled onto a line which conveys them through a waterbath stunner with their heads fully immersed.
- Required minimum currents to stun and kill dry birds are:
 - Quail - 100 mA/bird
 - Chickens – 160 mA/bird
 - Ducks & Geese – 200 mA/bird
 - Turkeys – 250 mA/bird.

A higher current is required for wet birds.

- An effective stun and kill should be verified by the absence of brain stem reflexes.

Advantages

- Stuns and kills simultaneously.
- Capable of processing large numbers of birds reliably and effectively.
- Non-invasive technique minimises biosecurity risk.

Disadvantages

- Requires a reliable supply of electricity.
- Handling, inversion and shackling of birds are required.

Conclusion

A suitable method for large numbers of poultry.

Method 3

Requirements for effective use

- The stunner control device should generate sufficient current (more than 300 mA/bird) to stun.
- Appropriate protective clothing (including rubber gloves and boots) should be worn.
- Birds should be restrained, at a minimum manually, close to an electrical supply.
- A stunning current should be applied in a position that spans the brain for a minimum of 3 seconds; immediately following this application, the birds should be killed (Article 17).
- Electrodes should be cleaned regularly and after use, to enable optimum electrical contact to be maintained.
- Birds should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes.

Advantages

- Non-invasive technique (when combined with neck dislocation) minimises biosecurity risk.

Disadvantages

- Requires a reliable supply of electricity.
- The electrodes must be applied and maintained in the correct position to produce an effective stun.

Conclusion

Suitable for small numbers of poultry.

Article 12

CO₂ / air mixture

Introduction

Controlled atmosphere killing is performed by exposing animals to a predetermined gas mixture, either by placing them in a gas-filled container or apparatus (Method 1) or by the gas being introduced into a poultry house (Method 2).

Inhalation of carbon dioxide (CO₂) induces respiratory and metabolic acidosis and hence reduces the pH of cerebrospinal fluid (CSF) and neurones thereby causing unconsciousness and, after prolonged exposure, death.

Method 1

Requirements for effective use in a container or apparatus

- Containers or apparatus should allow the required gas concentration to be maintained and accurately measured.
- When animals are exposed to the gas individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
- Animals should be introduced into the container or apparatus after it has been filled with the required CO₂ concentration, and held in this atmosphere until death is confirmed.
- Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
- Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

Advantages

- CO₂ is readily available.
- Application methods are simple.

Disadvantages

- The need for special equipment
- The aversive nature of high CO₂ concentrations
- No immediate loss of consciousness
- The risk of suffocation due to overcrowding
- Difficulty in verifying death while the animals are in the container or apparatus.

Conclusion

Suitable for use in poultry and neonatal sheep, goats and pigs.

Method 2

Requirements for effective use in a poultry house

- Prior to introduction of the CO₂, the poultry house should be appropriately sealed to allow control over the gas concentration.
- The house should be gradually filled with CO₂ so that all birds are exposed to a concentration of >40% until they are dead; a vaporiser may be required to prevent freezing.
- Devices should be used to accurately measure the gas concentration at the highest level of birds.

Advantages

- Applying gas to birds *in situ* eliminates the need to manually remove live birds.
- CO₂ is readily available.
- Gradual raising of CO₂ concentration minimises the aversiveness of the induction of unconsciousness.

Disadvantages

- Difficulty in determining volume of gas required to achieve adequate concentrations of CO₂ in some poultry houses
- Difficulty in verifying death while the birds are in the poultry house.

Conclusion

Suitable for use in poultry in closed-environment sheds

Article 13

Nitrogen/inert gas mixed with CO₂

Introduction

CO₂ may be mixed in various proportions with nitrogen or an inert gas eg argon, and the inhalation of such mixtures leads to hypercapnic-hypoxia and death when the oxygen concentration by volume is ≤2%. This method involves the introduction of animals into a container or apparatus containing the gases. Such mixtures do not induce immediate loss of consciousness, therefore the aversiveness of various gas mixtures containing high concentrations of CO₂ and the respiratory distress occurring during the induction phase, are important animal welfare considerations.

Pigs and poultry appear not to find low concentrations of CO₂ strongly aversive, and a mixture of nitrogen or argon with ≤30% CO₂ by volume and ≤2% O₂ by volume can be used for killing poultry and neonatal sheep, goats and pigs.

Requirements for effective use

- Containers or apparatus should allow the required gas concentrations to be maintained, and the O₂ and CO₂ concentrations accurately measured.
- When animals are exposed to the gases individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
- Animals should be introduced into the container or apparatus after it has been filled with the required gas concentrations (with $\leq 2\%$ O₂), and held in this atmosphere until death is confirmed.
- Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
- Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

Advantages

- Low concentrations of CO₂ cause little aversiveness and, in combination with nitrogen or an inert gas, produces a fast induction of unconsciousness.

Disadvantages

- Need for a properly designed container or apparatus
- Difficulty in verifying death while the animals are in the container or apparatus
- No immediate loss of consciousness
- Exposure times required to kill are considerable.

Conclusion

A suitable method for poultry and neonatal sheep, goats and pigs.

Article 14

Nitrogen and/or inert gasses

Introduction

This method involves the introduction of animals into a container or apparatus containing nitrogen or an inert gas such as argon. The controlled atmosphere produced leads to unconsciousness and death from hypoxia.

Research has shown that hypoxia is not aversive to pigs and poultry, and it doesn't induce any signs of respiratory distress prior to loss of consciousness.

Requirements for effective use

- Containers or apparatus should allow the required gas concentrations to be maintained, and the O₂ concentration accurately measured.
- When animals are exposed to the gases individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
- Animals should be introduced into the container or apparatus after it has been filled with the required gas concentrations (with $\leq 2\%$ O₂), and held in this atmosphere until death is confirmed.
- Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
- Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

Advantages

- Animals are unable to detect nitrogen or inert gases, and the induction of hypoxia by this method is not aversive to animals.

Disadvantages

- Need for a properly designed container or apparatus
- Difficulty in verifying death while the animals are in the container or apparatus
- No immediate loss of consciousness
- Exposure times required to kill are considerable.

Conclusion

A suitable method for poultry and neonatal sheep, goats and pigs.

Article 15

Lethal injection

Introduction

A lethal injection using high doses of anaesthetic and sedative drugs causes CNS depression, unconsciousness and death. In practice, barbiturates in combination with other drugs are commonly used.

Requirements for effective use

- Doses and routes of administration that cause rapid loss of consciousness followed by death should be used.
- Prior sedation may be necessary for some animals.
- Intravenous administration is preferred, but intraperitoneal or intramuscular administration may be appropriate, especially if the agent is non-irritating.
- Animals should be restrained to allow effective administration.
- Animals should be monitored to ensure the absence of brain stem reflexes.

Advantages

- The method can be used in all species.
- Death can be induced smoothly.

Disadvantages

- Restraint and/or sedation may be necessary prior to injection.
- Some combinations of drug type and route of administration may be painful, and should only be used in unconscious animals.
- Legal requirements may restrict use to veterinarians.

Conclusion

A suitable method for killing small numbers of cattle, sheep, goats, pigs and poultry.

Article 16

Addition of anaesthetics to feed or water

Introduction

An anaesthetic agent which can be mixed with poultry feed or water may be used to kill poultry in houses. Poultry which are only anaesthetised need to be killed by another method such as cervical dislocation

Requirements for effective use

- Sufficient quantities of anaesthetic need to be ingested rapidly for effective response.

- Intake of sufficient quantities is facilitated if the birds are fasted or water is withheld.
- Must be followed by killing (see Article 17) if birds are anaesthetised only.

Advantages

- Handling is not required until birds are anaesthetised.
- May be biosecurity advantages in the case of large numbers of diseased birds.

Disadvantages

- Non-target animals may accidentally access the medicated feed or water when provided in an open environment.
- Dose taken is unable to be regulated and variable results may be obtained.
- Animals may reject adulterated feed or water due to illness or adverse flavour.
- May need to be followed by killing.
- Care is essential in the preparation and provision of treated feed or water, and in the disposal of uneaten treated feed/water and contaminated carcasses.

Conclusion

A suitable method for killing large numbers of poultry in houses.

Article 17

Killing methods in unconscious animals

Method 1 Cervical dislocation (manual and mechanical)

Introduction

Poultry may be killed by either manual cervical dislocation (stretching) or mechanical neck crushing with a pair of pliers. Both methods result in death from asphyxiation and/or cerebral anoxia.

Requirements for effective use

- Killing should be performed either by manually or mechanically stretching the neck to sever the spinal cord or by using mechanical pliers to crush the cervical vertebrae with consequent major damage to the spinal cord.
- Consistent results require strength and skill so team members should be rested regularly to ensure consistently reliable results.
- Birds should be monitored continuously until death to ensure the absence of brain stem reflexes.

Advantages

- It is a non-invasive killing method
- Can be performed manually on small birds.

Disadvantages

- Operator fatigue
- The method is more difficult in larger birds.

Conclusion

This method is suitable for killing unconscious poultry.

Method 2 Decapitation

Introduction

Decapitation results in death by cerebral ischaemia using a guillotine or knife.

Requirements for effective use

- The required equipment should be kept in good working order

Advantages

- The technique is effective and does not require monitoring

Disadvantages

- Contamination of the working area with body fluids

Conclusion

This method is suitable for killing unconscious poultry.

Method 3 Pithing

Introduction

Pithing is a method of killing animals which have been stunned by a penetrating captive bolt. Pithing results in the physical destruction of the brain and upper regions of the spinal cord, through the insertion of a rod or cane through the bolt hole.

Requirements for effective use

- Pithing cane or rod
- Access to the head of the animal and to the brain through the skull
- Animals should be monitored continuously until death to ensure the absence of brain stem reflexes.

Advantages

- The technique is effective in producing immediate death

Disadvantages

- Delayed and/or ineffective pithing due to convulsions
- Contamination of the working area with body fluids

Conclusion

This method is suitable for killing unconscious animals which have been stunned by a penetrating captive bolt.

Method 4 Bleeding**Introduction**

Bleeding is a method of killing animals through the severance of the major blood vessels in the neck or chest that results in a rapid fall in blood pressure, leading to cerebral ischaemia and death.

Requirements for effective use

- Sharp knife
- Access to the neck or chest of the animal
- Animals should be monitored continuously until death to ensure the absence of brain stem reflexes.

Advantages

- The technique is effective in producing death after an effective stunning method which does not permit pithing.

Disadvantages

- Delayed and/or ineffective bleeding due to convulsions
- Contamination of the working area with body fluids.

Conclusion

This method is suitable for killing unconscious animals.